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Dissertation on wounds of the arteries with hemorrhage

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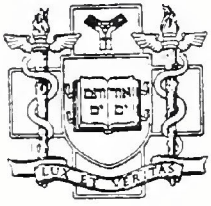

Yale University

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The Subject which I have chosen from the many topics which present themselves on this occasion is Wounds of the Arteries & Hemorrhage - But first it may be well to say a few words with regard to the Mechanism and use of these organs -

The Arteries consist of three coats which are 1st the external or cellular - this coat is strong and resisting under the application of the ligature being in strength superior to the other two which follow -

2nd The middle or fibrous, its fibres are arranged circularly in which direction they readily recoil to a ligature -

3rd The internal or serous coat this is a very thin delicate and transparent lining to the Arteries - its inner surface is quite smooth, thus favoring the circulation of the passage of blood through them -

This also guards very readily to the application of a ligature -

The arteries are supplyed with minute vessels called vasa vasorum - and also more or less with nerves - The whole is surrounded with a fibrous cellular tissue forming what is called the sheath of the artery -

The use of the arteries is to convey the blood from the heart to the different parts of the body - ramifying as they do through all the tissues dividing and subdividing into minute branches and capillaries where they anastamose with the minute branches of the veins through which the blood returns to the heart -

Each pulsation of the arteries corresponds with that of the heart, each contraction of the heart forcing from its cavity through the arteries a quantity of blood causing the pulsation which is felt under the fingers

A wound of the arteries may be caused by any thing that will wound the soft parts around them, and in the same manner the wound may be incised, lacerated or punctured though in a clean cut instrument will sometimes avoid the vessel to one side and thus cause it misaligned instead of wounding it

Symptoms - In a wound of an artery the most prominent symptom is hemorrhage more or less profuse according to the size of the vessel injured, size and form of the wound, and activity of the heart - Arterial hemorrhage however, the artery is of much size - from the nature of its coats they remaining open - & do not collapse as the veins do - and because the perpetual flow of blood from the main hemorrhage will be free - The blood will usually be of a florid color, lighter than venous blood and as a general rule it will flow out in successive jets, corresponding with each pulsation - it may however flow in a continued stream from the orifice of the

lower portion or extremity of the artery -
So also a vein when divided tends to send out blood by capillation - in consequence of its close proximity to some artery - there may be therefore a little difficulty in some ~~or case~~ instances in deciding whether the injury be of the one or the other - this may be readily ascertained however by making pressure in front of the wound on the limb above the wound - when if it is of an artery the blood will cease to flow, but if of a vein the hemorrhage will be more profuse, as the pressure opposing the retrograde current of blood through the valves will cause it to flow out through the wound -

Temporary Means for restraining Hemorrhage -
Nature has some modes of temporary relief - In the first place the ends of the arteries if divided will contract more or less thereby its orifice smaller - and then too it retracts so as to bury itself within the cellular substance which surrounds it -

And again the blood will coagulate in the wound and this jams up the end of the artery so as to restrain the further exit of blood from it. And so too frequently faintness comes on, and this both checks the flow of blood from the heart - and increases a tendency to coagulation in the wound -

But it may not be best to wait for nature to accomplish her work in all cases - especially if hemorrhage should be free - And temporary relief may be had while ~~permanent~~ permanent is being procured for, by pressure made with the finger over the open mouth of the vessel - That is when the wound is sufficiently large to admit of this - So also pressure made over the track of the artery - when it passes over a bone above the wound - as of the femoral artery when it passes over the pubis for a wound in the limb below will prove effectual - Or a handkerchief may be carried around the limb and tightly

twisted with a stick passing through it,
if a tourniquet is not at hand which ever
be more convenient to use - the handkerchief
when employed, must be applied, if to the
arm, above the elbow - if to the lower
extremity above the knee - that is to say to
that portion of the limb where there is but
one bone - as the two bones would be liable
to take the pressure off from the vessel -
It would be well to apply under the hand-
-kerchief and over the artery a compress
if there is one at hand and time to apply it
A punctured artery will bleed more profusely
than a divided one - as the ends are not allowed
to contract - or to bury themselves within the
surrounding parts - Lacerated arteries will
bleed less than incised ones, as they
immediately retract within their sheath - and
so too the ragged ends of the vessel retain
the blood and allow it to coagulate -
If the wounded artery is a small one at first
it may bleed violently for a time yet it will

generally be soon restrained by nature's
agency - and this may in some cases prove
permanently effectual - and if the artery be
of some size even and the wound so it
is a small one - it may be firmly closed
with coagulated blood and the patient
survive - But what would be more probable and
especially if the wound was of much size - is
that the patient would very soon become
exhausted and death would be the almost
immediate result unless artificial aid is
rendered - In some instances the temporary
relief which nature affords is but the foundation
of a fals hope - for in the course of a few
hours, when the heart has recovered its
usual activity and faintness has passed
off, secondary hemorrhage will come on -
and in this case - hemorrhage and a
suppression of it may alternate until
the patient becomes exhausted and death is
the result -

Of the prominent means of suppressing hemorrhage

the application of cold as of cold water cold air or Ice - will sometimes prove efficient where the vessels are small or where there is a general oozing from a surface - by causing contraction and increasing coagulation - In this case the wound must be kept open until the hemorrhage has ceased - But the safest, surest, and most readily employed means is the application of a ligature - For this purpose a variety of material has been used - yet perhaps it is of little consideration of what the ligature is composed so long as it possesses sufficient strength - it should be smooth and smooth the smoother it is the better it is, if it possess the necessary strength - as it will the more readily divide the inner coats of the artery - which is a matter quite desirable - and it must possess considerable strength to be capable of being drawn tightly enough for this - Some have preferred a ligature of animal substance thinking that it would be more easily, on the wound and cause less inflammation

than a common thread - and it is thought by some that the ends of the ligature can be removed leaving nothing but the loop around the artery, and that this will be absorbed causing no inflammation - in this case the wound can be immediately closed, and will most likely unite by the first intention - But absorbtion does not always take place in some cases inflammation and ulceration will come on - and an abcess will be formed and this will continue until the bit of ligature which was left in the wound is discharged with the matter from the abcess - The animal ligatures which are used are silk, those formed of the untwined skins of some animals as the kid or deer, the fibres of animal tendons &c, Our professor of Surgery informs us that he uses almost exclusively and prefers smooth linen thread -

Mode of applying a ligature - in applying a ligature to a healthy artery there is no danger

of dividing the external coat with almost any amount of force - the ligature should be carried around the artery in a directly transverse direction - and a single straight knot tied without lifting the artery out of its place, but with the thumbs carrying the knot down to it - and a second is to be tied in the same manner, - Now the external coat is contained within the ligature, while the cut edges of the inner coats being in opposition will unite by adhesion - The clot in the end of the vessel coagulates and is finely becomes changed into a fibrous cord - A ligature should be applied immediately to the vessel not embracing any thing besides - This can be easily done with the large arteries, but with the smaller ones there is more difficulty and with these it is not of so great importance the accompanying vein and nerve should never be wounded or injured on any way - But the ligature should be applied to the artery alone - and immediately at the place

When the vessel is in contact with the surrounding cellular tissue, the end of the artery may be drawn out with the forceps, or tenaculum, and the ligature applied. And when thus applied it will retract so as to bury itself at the place of ligature in its investing sheath. In the use of the tenaculum it should be carried through both sides of the vessel, for if but one side may be drawn down further than the other. and thus the ligature be applied to only a part of the artery. and secondary hemorrhage will very likely follow. A ligature should not be applied to an artery near where a branch is given off. Nor to a vessel near to the main trunk. as in this case the blood will not coagulate. and therefore when the ligature comes off secondary hemorrhage will be the result. A ligature should if possible always be applied to the artery at the place of the wound and not by insitions above it. And so too when will usually need

to be tied applied - one to each extremity or if the artery is only pulsating one at each side of the wound, and then the vessel divided - When a ligature is applied one end should be cut off as near to the artery as can be with safety to the knot and the other left to hang out of the wound -

In a varying period from five to eighteen or twenty days according to the size of the vessel separation will take place and the ligature may be removed - At the end of some days according to the size of the artery gentle traction may be made - This should not be exercised but three or four times in twenty four hours - Working it a little gently will prove effectual in dislodging it even when it is bound by adhesions -

In some cases where the artery is not easily obtained by other means the curved needle Needle may be used in this case the wound necessarily includes other matter than the artery therefore this is not the best mode when the

forceps or tenaculem can be used -
It will be seen sometimes that the blood
continuing to flow through the coagulum will
form protruding orifices which resemble those
of the arteries - and which have been mistaken
for them - but a ligature cannot be effectually
applied to them - and therefore the coagulum
must be removed - the mode of doing this
if the wound is sufficiently large is by
passing the fingers under it, and throwing
it out in a mass - And thus saving the
pain and perplexity of washing it or
picking it out bit by bit with the
forceps - then the arteries may be found
and secured

Torsion - or twisting and lacerating the end
of the artery has sometimes been employed
this can be done by fixing the artery at
a little distance from the end with a forceps
and then with the second pair twisting and
lacerating the end of the vessel - this mode of
treatment may answer for small vessels but

should be readily distinguished from large ones - the artery being a deep one and the wound so small as to prevent access to it - this can be remedied by making the wound larger with incisions - and it would be best to do this when it can be done and in some cases pressure may prove effectual - When this is employed a graduated compress should be applied first to the part of the wound - and then should be a compress applied also along the track of the artery above and the whole limb should be enveloped in a bandage to prevent the accumulation of blood in it - It will be well to keep the wounded part in an elevated position - A variety of styptics are used - some of them act by the contraction of the vessels which they cause - others by their tendency to produce coagulation of the blood - some it is said by their mechanical obstruction to the flow of blood - and some by their production of inflammation and granulation and thus

bringing or adhesion of the opposite sides of the vessels - for this purposes all the vegetable astringents may be used as also the mineral - the muriated tinct of iron is beneficially injected into a wound in some cases - or the nitrate of silver may be used - ~~a the citt of lead~~ - and perhaps common alumn is as good as any of these remedies - this is often effectual in those cases where the wound and artery are both small - a piece of alumn cut of the size and shape of the wound and introduced so as to reach the bottom and then a compress and bandage applied over it to sustain it in its place - one advantage of this is that it will lie easily on the parts - and will not produce inflammation - this remedy has a tending to contract the tissues - and besides this it causes a speedier hard coagulum of blood to be formed which restrains the hemorrhage -

A wound or puncture of an artery with out
bleeding - in this case the wounded
vessel should be divided - and then
its contraction may cause its bleeding
to cease -
The actual cautery has been used by
some - where the wound is deep and
the artery difficult to get at - but
this is not to be practiced generally
or except in extreme cases - when
employed the iron should be of
sufficient size to cover the whole
breadth of the artery - heat to a red heat
and when applied kept in motion
to prevent adhesion of the parts to it